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A Distinguished Bird Artist

The Rock-cut Church at Gurat

Ancient Man at Fengate



ROTUNDA

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Focus Dorothy K. Burnham

2

Cliffs, Caves, and Hermits Veronika and Michael Gervers
The Rock-cut Church at Gurat

5

A Debt to Prehistory Madeleine A. Fritz
Fossils in the Service of Man

15

Elizabeth Gwillim Terry Shortt
A Distinguished Bird Artist

20

The Growing Collections

30

Ancient Man at Fengate Francis Pryor
Britain's Past on the Move

34

Eagle Owl (*Bubo bubo*).
A painting by Elizabeth Gwillim,
page 20.



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on Betty Brett

Dorothy K. Burnham



Katherine B. ("Betty") Brett has retired, and the Textile Department is bereft. Like the magnet that it is, the Museum will draw her back, but it will be to her own research, not to rise gaily, as she has been doing for years, to the constant and incredibly varied demands of normal museum work. She will be missed by a whole range of people who have come to rely on her wide knowledge and her generosity in sharing it.

Betty Maw joined the Museum staff as a comparatively recent graduate of the College of Art in 1938 in the capacity of draughtsman. Because of her interest in prints and printing methods, the rotation of displays drawn from that collection was added to her more mundane duties. During World War II she went overseas with the Red Cross, and when she returned to the Museum in 1945 she joined the staff of the Textile Department, becoming curator in 1950. Her marriage to Gerard Brett, head of what was then the division of Art and Archaeology, strengthened her museum career, for with their common interest in the decorative arts she and her husband were able to work as an informal team, supporting each other's research.

Her work with textiles has been wide ranging, but two major research areas have emerged: the study of costume and, growing from her initial fascination with printing, the painting and printing of fabrics, on which she is one of the world's great authorities. Both subjects are firmly based on the Museum's strong collections in these fields. In 1968 Betty became Associate Curator, relinquishing the administration of the department to Harold Burnham in the hope that she would have more time for specialized work. With Harold's death in 1973 she unselfishly picked up the reins again and has guided a very vigorous department through these last two difficult years. These are the bare facts of Betty Brett's career, but they tell little of the unique contribution she has made to the ROM.

Those of us on the staff of the Museum know well the question that frequently comes when a stranger learns where you work: "Just exactly what do you do at the Museum?". If you don't use the time-worn reply "I dust the mummies", it is almost impossible to answer. Just exactly what has Betty Brett done at the Museum? If you reply "Everything", it is true, but what is everything? If you reply "She has been an outstanding curator", what does that mean? She has gathered material, studied it, learned about it, and loved it, and has translated her love and knowledge



into a form that others could grasp, thereby learning to enjoy and understand the material too. She is a scholar. The magnificent book *The Origins of Chintz*, which she wrote in collaboration with John Irwin of the Victoria and Albert Museum, is a definitive work on a hitherto almost unstudied area of textile history. The beautiful exhibition which she mounted to accompany its publication in 1970 showed strongly another area of her museum skill, for it was a glorious feast of colour and design, secure as an artistic creation in its own right, and yet, because of its firm basis of scholarship, not just an art show but an outstanding and memorable museum exhibition.

The same was true of the 1967 exhibition of Canadian costume "Modesty to Mod". It was a stunning display, exciting and fun to see, but because the knowledge of the subject had been built up by years of research, it was also far more than that. It was Katherine B. Brett, the noted authority on costume, making a firm statement on the social history of our country, and the catalogue that accompanied the exhibition has become a sought-after rare book.

Betty Brett is both scholar and showman, but museum work takes more than that. A good curator does not just take the collections transmitted from the past and use them as they are, but sees it as a duty to pass those collections on to the future strengthened and better balanced. Collections are increased in two ways, by gift and by purchase. Betty Brett has proved to be very good at fostering both methods. Many gifts come unsolicited, but it is not enough to sit in the office and wait for them to come. There is as much skill and excitement in unearthing them as our archaeological colleagues have with their "digs", and

the same is true of the purchases. A precise knowledge of values, rarities, dealers, and the relevant importance of objects must be carried in the mind of the curator at all times. Based on that complex knowledge rapid decisions may sometimes have to be made. Good buys don't sit around and wait while a committee makes up its mind; they must be grasped at the moment, and this takes courage. Betty Brett has been a collector of knowledge and vision.

But, again, collecting and researching are useless unless the material is well cared for, and to all her other skills Betty Brett has added those of a good housekeeper. The stereotype of a museum curator may be someone sitting in an ivory tower peering through a microscope, but Betty was as likely to be found at the top of a ladder checking into the storage, or on her knees in a case making sure that a costume was hanging exactly right, as at her desk dealing with visitors and business.

When she joined the staff thirty-seven years ago, Betty Brett was a young enthusiast. She is now an older enthusiast with an internationally recognized stature, and the Department has matured with her until it ranks as one of the great textile collections in the world. The textile galleries will be turned over to a special exhibition "Curator's Career" from November 11 to February 29 as a tribute to Betty Brett. Varied aspects of her work will be displayed, giving a better idea of the scope of her accomplishments and the enrichment that she has brought to this institution than can be done with words. Come to see it. It will show what can be accomplished by one woman in one lifetime.



Cliffs, Caves, and Hermits

The Rock-cut Church at Gurat

Veronika and Michael Gervers

Gurat is a quiet little village in southwestern France, some twenty-five kilometres directly south of Angoulême. Its population of 250 has decreased by thirty per cent in the last decade and is still dwindling. The inhabitants work on the land, or are employed by the local seigneur, the mayor, in his stone quarry. There are two *épiceries*, a seed merchant, a café-restaurant, a gas-station-cum-café, and a post office. Bread comes from a village down the road (great two-kilo couronnes that look like huge doughnuts but taste infinitely better); milk comes direct from the cow, and *escargots* appear with the morning dew. Reflected by the wheat fields, absorbed by the age-old, red-orange roof tiles, the afternoon sun turns everything golden.

The village is ancient, and probably had its origins in a Gallo-Roman villa called *Auguracum*. A few kilometres away a former Roman road, straight as an arrow, still carries traffic. A mediaeval keep with thick foundation walls is all that remains of a once proud, now forgotten castle. The charming little Romanesque church dates from the late eleventh or early twelfth century. But there is also a more unusual kind of church. Built as it is on top of a limestone cliff overlooking the Lixonne River (and only a few hours' journey from the renowned prehistoric caves of Lascaux), Gurat is the site of a most unexpected phenomenon: a mediaeval cave-church.

This monument is carved out of the cliff on a ledge directly beneath the village. It is the central element of a much larger complex consisting of a series of hand-tooled grottos. These occur on two levels, beside the church and along the valley floor directly below it. Communication between the upper and lower levels was achieved by means of a stairway hewn out of the cliffside. Seventeenth-century farmhouses lie directly above the cave, and only a metre of stone separates the top of the church's vault from the floor of M. Aubugeau's living room. If you stand in one of the eight adjacent cell-like grottos you can hear footsteps and voices from the storehouse of M. Mallet the greengrocer. Basing their confidence, perhaps unwisely, on the fact that there has never been a cave-in in human memory, the occupants are not in the least concerned about the possibility of such a calamity. In fact, they pride themselves on having at hand a ready-made bomb shelter large enough to hold the

Photographs by M. Gervers, H. Roe, D. and C. Wiltenburg,
and D. Wiegmann

Gurat with its rock-cut church, seen from the valley.

entire population of the village.

When excavation began at Gurat in 1965, the rock-cut church was serving one of its less honourable peacetime rôles; that of a rubbish dump. Since its secularization in the late sixteenth century, it had been used at various times as a saltpetre factory, an iron foundry, a stable, and a shelter for refugees and tramps. In the nineteenth century one of the adjacent grottos had been turned into a bread oven. An elderly villager still remembers his father having baked bread there, once every two weeks: "Que c'était dur vers la fin de la quinzaine!"

After removing the inorganic debris from the dump we were able to lay out a few trenches in search of the site's extremities and of the original floor level. Working in an easterly direction from the point where the triumphal arch separated the interior of the church from the exterior cliff face, we came upon a series of three steps leading up into what had once been the sanctuary. Low benches had been fashioned out of natural rock on either side, and

the passage terminated in a horse-shoe apse. The foundations were cut from the rock ledge in front of the cliff, but the superstructure had been built of small stones and mortar. With this exception, the entire church had been carved by countless blows of hammer and chisel, with enduring patience and faithful determination, out of the limestone cliff.

In the absence of any kind of written or iconographical evidence, it is impossible to tell even from the architectural form when those busy hammers and chisels first set to work. A centre for neolithic flint-making lies in a field only a few hundred metres away, and it is quite possible that the grottos belonging to the church complex originated as rough natural shelters under the overhang of the limestone cliff, and had been used by prehistoric peoples for centuries. Major habitation sites of prehistoric man abound in the area, which was always an attractive one because of the many natural caves carved out of the soft limestone by erosion and subterranean streams.

Such a site would have been

equally desirable to an early Christian hermit, especially if a community dependent upon some nearby villa could supply him with food. We believe that such a mediaeval hermit did inhabit the place. Whoever he was, he must have been extremely devout and saintly, for as time passed he was joined by others, and a small eremetical community arose, perhaps as early as the fourth century A.D. At some point between the ninth and eleventh centuries the group undertook to carve a church out of the cliff face, in the same manner that they had carved their individual cells.

The present structure is oriented towards the east. It consists of a nave and a north aisle, entered from the northeast by an impressive descending passageway. The interior measures 17.5 metres (57 ft., 4 in.) long, 9 metres (29 ft., 6 in.) wide, and 6 metres (19 ft., 8 in.) high. Nave and aisle are separated by two massive rock-cut pillars, and non-functional engaged pillars occur at intervals around the walls. Roughly cut cavities in the south and west walls indicate that after completion of the nave

View facing east through triumphal arch.

Opposite page: The cliff ledge, looking north (1973).





and aisle the decision was made both to lengthen the church and to build a south aisle similar to the one on the north side of the nave. Perhaps because of war or pestilence, however, the work was suddenly abandoned. A belfry stood on the cliff above the east end of the nave, and a cluster of six bell ropes hung through holes in the vault.

The rock-cut church at Gurat may be an extraordinary architectural form, but it is not unique in Europe and can hardly be considered rare in the Mediterranean Christian world. Ecclesiastical monuments of a similar type exist from Spain to the Caucasus and from Syria to Ethiopia. The extensive communities to be found in Cappadocia and Phrygia in Turkey, and at Matera in southern Italy, are well known. These are all Byzantine

sites and the subterranean monuments reflect closely the architecture of their counterparts constructed above the ground. The interiors of many are covered with numerous frescos of high quality. These have received the attention of mediaeval art historians, but architectural and ecclesiastical historians as well as archaeologists have kept their distance, with the result that very little is known about the origins and development of these communities. As yet no adequate vocabulary has been devised to describe them. But despite the incomplete state of our knowledge, we have little doubt that the inspiration for such rock-cut churches was derived from the example of the early Christian desert fathers. It is still too early to tell whether the Western European communities were

influenced directly by Byzantine custom, or whether each developed along separate lines from a common origin. The Byzantine rock-cut churches are more numerous and seem to be earlier than those in the West. Yet if the western churches copied an eastern idea, they did not imitate Byzantine form, but rather local church architecture.

We know of no fewer than ten other rock-hewn ecclesiastical sites within 100 kilometres of Gurat that once served as centres of sizeable religious communities. Only two of them, Aubeterre in the Charente and Saint Emilion in the Gironde, have churches larger than the one at Gurat. They provide us with important sources of comparison, for we believe that they were all part of a flourishing trans-European eremetical movement that began in the early



Middle Ages, scraped through the subsequent period of invasions, developed in the ninth and tenth centuries, and flourished during the eleventh century and on through the mid-thirteenth.

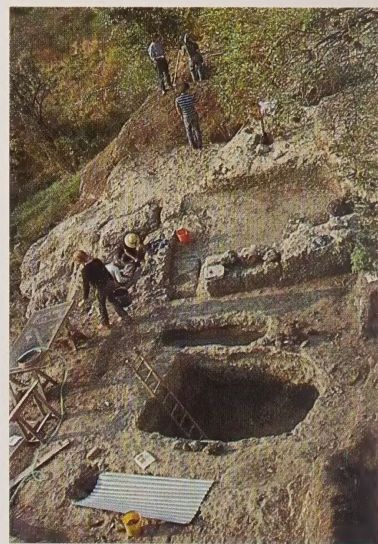
Emilion was an eighth-century Breton saint who at some time around A.D. 750 made his way up the Dordogne river to a secluded spot then called *Ascumbas*. Here he decided to stay and, apparently on his own, set about carving a cell and an oratory for himself out of the rock. He must have been a most pious man, for his reputation spread. Others came to share his spiritual wealth or, after his death, to honour his shrine, and they copied his example. Cell after cell was chiselled from the rock, and the community grew. At an early date the name of the place was changed to commemorate the saint, and it now graces every bottle of what connoisseurs know to be one of the very finest of clarets. Few of them know, however, the part that Saint Emilion played in the story.

Nothing certain is known about the origins and subsequent history

of the other rock-cut religious sites in the area, not even about Aubeterre which, before the collapse of most of its nave and south aisle, was the largest of the Big Three. Judging from the enormous, carefully fashioned crypt with its double entry, important relics must have been buried there and large pilgrimages made to pay them homage.

For the archaeologist, one of the most fascinating aspects of the rock-cut churches at Saint-Emilion and Aubeterre was their use as necropolises or cemeteries. Although most of the former has, fortunately, not yet been excavated, a number of graves and grave niches are visible along the base of the walls. At Aubeterre, sadly and brutally over-excavated during the past fifteen years thanks to a wealthy opportunist, a compliant landscape engineer, and an absentee archaeologist, some 600 graves were unearthed in the floor of the church itself and their skeletal contents uncere- moniously dumped into a large, water-filled pit.

In Gurat we discovered the



Top: The cliff ledge with the remains of the masonry apse vault, looking south. The top of the triumphal arch is also visible.

Lower: The cliff ledge with burial pits, looking south.

Opposite page: The interior of the church, north aisle and apse, facing east.



cemetery not inside the church, but on the ledge directly in front of it. In 1973 three symmetrically arranged graves were unearthed between the apse and the entrance; a large central rock-cut cavity flanked by two smaller ones. The central cavity yielded the skeletal remains of two male adults and a newborn infant. One of the adults was apparently a former leader of the community, for a special inner tomb had been constructed around his body within the cavity itself. One of the flanking graves held the skeleton of a female, the other of a male.

In 1974 we found the remains of others, including children, adolescents, and adults, in another series of graves cut out of the rock along the same ledge lying directly in front of and running south from the choir apse. These cavities were laid down in a more regular fashion with less room and in a less accessible area than the symmetrical grouping mentioned above. They may have

been intended for less prominent individuals, or perhaps were dug at a time when space on the ledge was at a premium. Only one of the skeletons from the area excavated was found *in situ*; the others had all been badly disturbed. Further excavation in the immediate area is hindered by a large chestnut tree which neither we nor the owners of the site wish to destroy.

What was to be made of this graveyard? Did it contain the burials of a mixed eremetical community or of the village which protected and supported it? The question remains unanswered, although we are inclined to favour the first possibility. Relatively undisciplined eremetical communities containing both men and women were by no means unknown; hence offspring were not unlikely. The village graveyard was situated beside the Romanesque church on the cliff above, and it is there that members of the village community would have been interred.

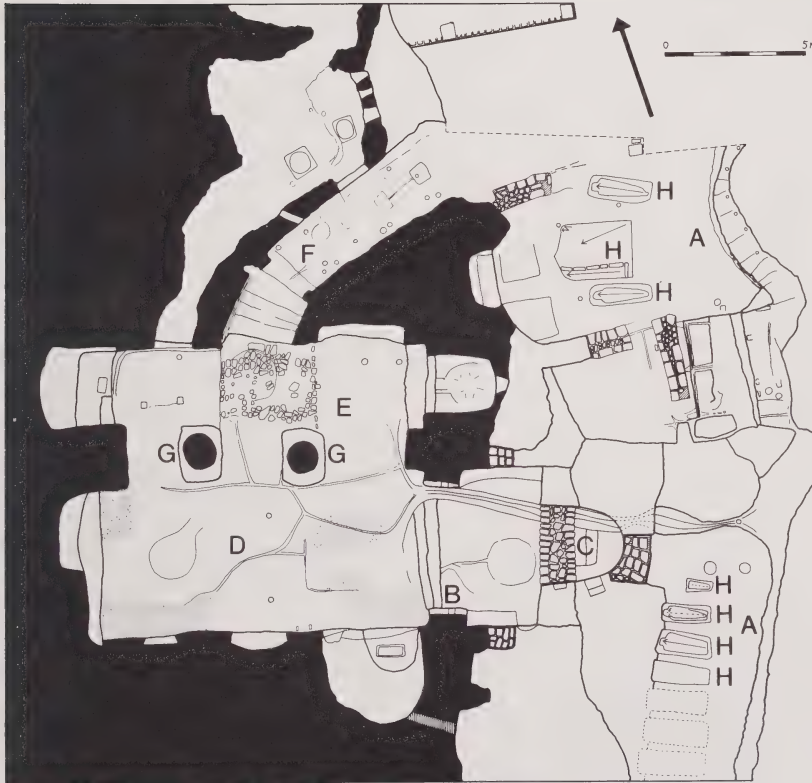
We do not know when the bodies of the excavated skeletons were originally laid to rest, although our ceramicist, Dr. Jerzy Kruppé of the Polish Institute of Material Culture, believes that the scanty sherds associated with them may belong to the twelfth or thirteenth century. The bones themselves are being analysed by Frederick and Catherine Gretenhardt under the direction of Professor Geoffrey Gaherty, physical anthropologist at McMaster University. Chemical tests to determine blood type, age, sex, and length of burial are being performed by Dr. Imre Lengyel of the Hungarian Academy of Science. Metallurgical studies are in the hands of Professor Ursula Franklin of the University of Toronto.

The origins and early history of the rock-cut community at Gurat remain veiled in a cloud of uncertainty, yet the mist is slowly rising. Later stages in its development are less obscure. At its zenith, proba-





Above: The interior of the church, facing west.



Opposite page: Disturbed burial from a grave in front of the apse.

Left: Ground plan of the church.

- A. Cliff side
- B. Triumphal arch
- C. Sanctuary with apse
- D. Nave
- E. Side aisle
- F. Entrance passage
- G. Columns
- H. Graves

bly in the eleventh and twelfth centuries, the church must have been impressive. The interior was covered with white plaster, so that the spectator would have had the impression of being in a free-standing structure built above the ground. In the apse vault, and perhaps elsewhere, the plaster was covered with red frescos. Since there was no natural light except at the east end, oil lamps were placed in niches hewn out of the walls and columns. Paving stones covered the channels through which drainage water passed.

All this changed as the Middle Ages progressed. A group of coins dating from 1237 to 1295, excavated from a large storage pit in a room to the north of the entrance passageway where they had been buried for safe-keeping, suggests that at some point in the fourteenth century the community was threatened from without. According to local legend, the bells were removed from the belfry and hidden in a bottomless spring (whence they were never retrieved) to keep them out of the hands of the English armies during the Hundred Years' War (c. 1342–1453). Debris consisting of thirteenth- or fourteenth-century

pottery mixed with a great deal of mortar and white plaster, some of it bearing traces of frescos, was found in an early hard-packed floor level inside the church. One may conclude from the coins, pottery, and plaster that the site suffered serious damage during the war. It appears never to have regained its former status. A dwindling community hung on for another two centuries after the Black Death decimated the populations of town and country in the mid-fourteenth century. But the wars of religion in the late sixteenth century delivered the final coup de grâce. The community was sacked, the stone-and-mortar vault over the choir and apse destroyed, and a number of skeletons from the rock-cut graves disinterred and scattered.

As we have seen, mediaeval rock-cut churches, chapels, and oratories are not uncommon, yet for lack of documentation and sufficient historical research they are poorly understood. Excavations at Gurat are a mere scratch on the surface of a major cultural tradition which was at one time quite widespread in southwestern France. Excavations alone will not answer the many questions which still surround that tradi-

tion, particularly since the finds are relatively infrequent and their meaning often unclear. The eremetical community that lived there was extremely poor and left few material goods as evidence of its passing. Following the custom of Christian burials, they interred no artifacts with their dead. Furthermore, because the site is cut out of the rock rather than built on top of it, there is practically no stratigraphy to go by before the sixteenth century, when the place was abandoned. For the same reason it is nearly impossible to trace the various construction periods.

Finally, the archaeology of the French High Middle Ages is still in its infancy. So rich is the country in surviving monuments above the ground that its art and architectural historians have had neither the time nor interest to study what exists below the surface of the earth. Consequently, very little is known about the country's mediaeval pottery and other common objects of daily use. Only when work on contemporary sites has been carried out and the results published will the comparative material necessary to the historian's craft become available.



Interested in mediaeval architectural history and eremetical movements, the Gervers started the excavations at Gurat in 1965 with voluntary help and the assistance of the village. The 1966 and 1973 seasons were run on a similar basis, the former supported by the International Centre of Mediaeval Art and the latter by New York University and anonymous donations. For the first time in 1974 the excavation was organized as a credit course sponsored by the History Department of New York University. Nineteen graduate and undergraduate students from five universities in Canada and the U.S.A. participated. Permission to work at the site has been generously accorded by the

owner, M. Jaques Aubugeau, the mayor of Gurat, M. Michel Chat, and by both the *Direction Régionale des Antiquités Historiques* and the *Conservation Régionale des Bâtiments de France de Poitou-Charentes*.

Veronika is Associate Curator in the Textile Department and has been with the ROM since 1968. Michael is Assistant Professor of History at New York University and Research Associate at the Pontifical Institute of Mediaeval Studies, Toronto.

View facing southeast through the triumphal arch.





The wall of the Niagara gorge,
showing capping rock at the top.



A Debt to Prehistory

Fossils in the Service of Man

Madeleine A. Fritz

It may seem odd to think that fossils, the remains of prehistoric animals and plants entombed by natural processes in rocks of the earth's crust, could in any way influence our lives today; yet they do, for they have helped materially in building our present civilization. Many have contributed to the formation of deposits essential to the world economy; others have played a part in some of the great industrial developments of this century.

It was geological events that led to the preservation of fossil organisms that lived millions of years ago in prehistoric seas. Remember that the position of lands and seas has not remained constant throughout time: what is dry land today was often covered by seas in days gone by, as was Toronto 400 million years ago. In fact, levels of continents and sea floors have been (and still are) very gradually changing as the earth adjusts to the ever-present forces of nature. As seas of old advanced on the land, they deposited sands, muds, and limy oozes, and in these sediments marine organisms became buried when they died. Later, when the marine waters receded, the sediments left behind became compacted rocks, such as sandstone, shale, and limestone, and in these rocks are preserved the fossilized remains of some of

the life that flourished in the long-vanished seas. Geologists have been able to estimate the approximate age of successive rock sequences. Palaeontologists have identified well-preserved fossils in rocks of the Cambrian Period, which dates back at least 600 million years; furthermore, meagre remains of soft-bodied microscopic organisms, such as algae, have been found in rocks over two billion years old; these are among the oldest traces of life known today.




From the Cambrian onward, the rocks formed in each geological period contain characteristic fossil assemblages, and each formation in turn contains forms of higher organization than the preceding; hence fossils help to date the rocks in which they are found. The gradual progression from lower to higher forms of life that is revealed as we move from older to younger rocks provides evidence in support of the doctrine of organic evolution. In the earth's history, fossils, the record of nature, serve to date rocks, just as in man's history, human artifacts distinguish successive cultures.

Of the rocks that had their origin in the ancient seas, limestone is a common and familiar type. Many limestones were formed largely from the remains

of prehistoric shellfish, the calcareous shells of which provided the lime. Limestone underlies many areas of the world; some large cities—Paris, for example—are built on limestone formed mainly through the agency of low forms of past life. The special uses of limestone are too numerous to recount. As a building stone, its architectural possibilities are manifold, and marble, a metamorphosed limestone, has featured in sculpture and architecture all through human history.

Some limestones are made up essentially of one particular kind of fossil, the remains of which abounded in the sea at the time the rock was being formed. Take the limestone of Egypt and other neighbouring areas in the Mediterranean region. Some fifty million years ago a great inland sea, much more extensive than the Mediterranean of today, covered northern Africa. There it left limy deposits, now rock, filled with a fossilized, one-celled animal known as *Nummulites*, a name which means "coin". The ancient Egyptians quarried this rock and from it built the pyramids, which have survived to this day as royal monuments and burial places. Many domestic vessels and objects of art were also made of this limestone, as the Egyptian collections of the ROM attest.

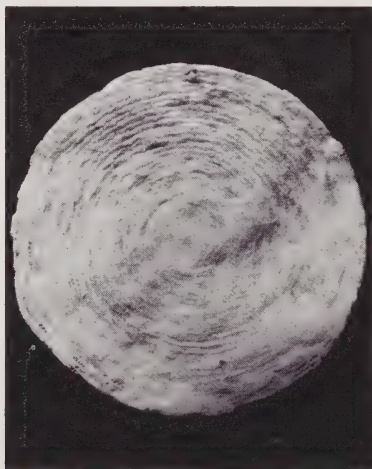
Opposite page, lower: Fossiliferous rock with brachiopods.

ERA	MY.	PERIOD	LIFE
CENO-ZOIC	1.5	QUATERNARY	
	70	TERTIARY	
MESOZOIC	71	CRETACEOUS	
	44	JURASSIC	
	45	TRIASSIC	
PALAEOZOIC	55	PERMIAN	
	65	CARBONIFEROUS	
	50	DEVONIAN	
	35	SILURIAN	
	70	ORDOVICIAN	
	70	CAMBRIAN	

Above: Time chart, showing the duration of each successive geological period. (John Monteith and Huibert Sabelis, Department of Invertebrate Palaeontology, ROM)

Right: Nummulites.

Opposite page: Egyptian urn and platter of nummulitic limestone (Egyptian Department, ROM).



Another rock-forming, one-celled creature is *Fusulina*, the shells of which resemble grains of wheat. These creatures were so abundant and widespread in the seas of two to three hundred million years ago that extensive limestone deposits composed of their remains can be traced in many parts of the world. In some places these limestone deposits underlie large areas and are quarried for various purposes. Cement, which has now replaced limestone to a large extent as a building material, is itself made from limestone and clay, or from a natural rock, known as water-lime, which contains these constituents in the right proportion.

There are many other forms of fossil life that have influenced our industrial development, or are linked with products of great economic importance. Would you have thought that the Ontario Hydro development at Niagara Falls is in part indebted to fossils? The falls themselves are a geological feature in which extinct life has played a significant role. The rocks of the gorge-wall cut by the Niagara River are made up of red and grey thin-bedded shales with intervening layers of heavy-bedded grey limestone and dolomite (magnesium limestone). The uppermost beds of the gorge-wall are the most massive and resistant to weathering. These heavier rocks have protected from erosion the softer shales that lie beneath, and without them there would be no falls, for the shales would soon disintegrate and be washed away by the swiftly flowing river. While all the rocks of the area of the gorge are sea-made and contain many fossils, the protective upper beds are built up largely from the shells of fossil organisms. Thus the very rocks that make possible the falls, and hence the electric power of south-western Ontario, are of organic origin.

In addition to the many limy shells in the capping rocks at Niagara Falls, there is one partic-

ular kind of fossil that is responsible in a large measure for rendering the strata more resistant. This fossil belongs to an extinct group of sponges. Imagine a sponge lending strength to a rock! However, in the seas of the Silurian Period, which deposited the Niagara sediments, there flourished a profusion of sponges that secreted intricate skeletons of silica, a hard substance which is the main constituent of quartz, flint, chert, and glass. Since they were not readily soluble, the skeletons have remained relatively unchanged through all the millennia that have elapsed since they were part of living creatures. These flinty remains serve much the same function as did the flint fragments that the ancient Romans mixed in mortar to strengthen their great fortifications. Often the reinforced mortar has remained while the blocks of stone have disintegrated.

But water power is not the only commodity in which fossils have played an important part. The petroleum industry has also benefited from these ancient creatures. Oil and gas deposits are derived from soft-bodied, microscopic plant and animal life that

thrived abundantly in the shallow coastal waters or floated on the vast expanses of the prehistoric gas. Dead bodies of these organisms by the billions rained down into the accumulating sediments, and in decomposing provided the constituents of oil and gas. Later, when the seas receded, the sediments solidified into rocks that retained the natural hydrocarbons of which petroleum deposits are composed. At the outset these materials were widely disseminated throughout the rocks, but later, through various natural agencies, they were gathered together. Through capillary action the oil and gas might be forced in all directions through small openings in the solid rock; or pressure might force the constituents from a compact source-bed into porous rock; then circulating waters might further aid transportation of the elemental substances.

In spite of all this, no reservoirs of oil would form if the rocks containing the hydrocarbons remained in their original horizontal position. The rocks must be deformed in order to provide lodging places or traps for the oil or gas. Many traps have resulted

from folds caused by horizontal thrusts in the earth's crust. But others owe their origin to the fact that the rocks were laid down over a "reef" built up on the ocean floor; many such reefs have been formed by accumulations of fossilized corals and other marine organisms.

So oil fields may develop. If such fields are hidden deep in the earth or ocean bed, they must be located, and this is now usually done by geophysical prospecting. Once a field is located, a plan for its development must be determined by subsurface investigations. Here again fossils may play a part, for much essential information is provided by the fossilized remains of plants, such as pollen grains, seeds, cuticles, and so forth, and also by the remains of microscopic unicellular animals that come up undamaged in successive bailings or cuttings obtained in the drilling of wells. The study of these fossils aids greatly in determining the age of the rocks penetrated in drilling. The fossil associations and sequences in the wells of a producing oil field can serve as a pattern or guide for comparison with other areas where oil possi-



bilities seem favourable.

The world's coal supply owes its origin not to ancient marine organisms of low organization, but to plant forms of high organization. About 300 million years ago large areas in the world were covered with dismal swamps. In Canada, parts of Nova Scotia and New Brunswick are typical areas in which these conditions prevailed. These swamps nurtured a profusion of plants, some reaching tree-like proportions. Many have left no living representatives on the earth, but descendants of others may be seen in such significant members of our modern floras as the tiny horse-tails and club mosses.

These swamps, with their luxurious growth of vegetation and mild, moist climate, provided ideal conditions for the ultimate formation of coal. Year after year, generation after generation, age after age, the vegetation became buried. Bacteria broke down the plant tissues; oxygen and hydrogen were released; and peat bogs were eventually formed. The process did not stop there, for the swamps gradually sank under the accumulated burden, and the land was lowered and encroached upon from time to time by the sea. With the passage of time the sea deposited thick sediments (later compacted into rocks), the weight

of which produced sufficient heat and pressure to help convert the peat to lignite, and the lignite to bituminous coal; a continuation of these processes led to the formation of anthracite. Most of the world's coal supply was produced in the remote period known as the Carboniferous or "carbon-bearing" age, but some was formed in later geological periods.

Economic contributions have also been made by vertebrate fossils, the remains of animals with backbones. Their role has not been as significant, however, as that of invertebrates and plants, because the conditions in which land vertebrates lived made their preservation as fossils less likely. Only if they chanced to fall into swamps or became mired in tar pits were they likely to become fossilized. If they fell into crevasses in glaciers during the Ice Ages, both their carcass and their skeleton might be preserved intact. But if they died in the open, their soft parts soon decomposed or were devoured by other animals. Their skeletons then disintegrated and ultimately became part of the soil.

Though relatively few fossil vertebrates are found, they have nevertheless been sufficiently plentiful at times to produce materials that can now be put to useful purposes. The bones of

vertebrates and the excrement (guano or coprolites), especially of carnivorous animals, including reptiles, birds, and mammals, occasionally constitute a comparatively large percentage of certain stratified rocks. Phosphate beds may result. Such deposits have resulted at intervals throughout geological history, at least as far back as the Carboniferous period. Phosphate (old or recent) is of considerable economic importance as a fertilizer.

The last source of revenue to be considered involves the fossils of extinct species of elephants. During the past million years, when vast ice sheets covered large proportions of the northern hemisphere, huge herds of mastodon and woolly mammoth followed the borders of these great continental glaciers. Many of their skeletons are found in the debris left behind by the melting ice. In Canada such fossilized skeletons are found in all latitudes from coast to coast, buried in gravels, sands, and clays. In Siberia, however, these animals have been found in the frozen tundras where they had fallen into crevasses in the ice; their carcasses have been sufficiently well preserved to be devoured by dogs or to be used as bait in trapping foxes. So numerous have been the discoveries of mammoth tusks in Siberia



Mallet made from section of mammoth tusk (Department of Vertebrate Palaeontology, ROM).

Opposite page: Fern-like plants from Coal Age rock.

that a flourishing ivory trade existed there for nearly two and a half centuries, from 1692 to 1923. About 70,000 lb. of ivory were exported annually during these years, and the trade has been traced back to 500 B.C.

Generally speaking, fossil tusks have not been found in Canada in sufficient numbers to be of any economic importance. In the Klondike region, however, some use was made of specimens discovered during the gold rush of 1897. Mallets fashioned from cross-sections of large tusks are said to have been used by prospectors as sledges for breaking ground in their search for gold.

Man owes a great material debt to the orderly succession of fossils through the various periods of earth history. Without such relics he might never have produced many of the artistic and technological achievements of his past and present. Above the entrance to the Royal Ontario Museum the following inscriptions appear: "The Record of Nature through Countless Ages" and "The Arts of Man through the Years". Nowhere is the intimate relationship between man's arts and nature's works more evident than in human reliance on the contributions of fossil populations in the building of both ancient and modern civilizations.



Madeleine A. Fritz, Professor Emeritus, University of Toronto, has been associated with the Royal Ontario Museum for over three decades during which period she has held a number of key positions. Dr. Fritz is a specialist in the study of Palaeozoic bryozoa and as Research Associate in the Department of Invertebrate Palaeontology, ROM, is engaged in redescribing the Type Specimens from the Ordovician of the Toronto region which are in the ROM collections. Her publications have been appearing as ROM Life Science Contributions since 1970.



Elizabeth Gwillim

A Distinguished Bird Artist

Terry Shortt

Madras, India, 1800: The long sea voyage from England to India was over. Sir Henry Gwillim K.C.M.G., of Hereford, accompanied by his bride, Elizabeth, had come to Madras City to preside as one of His Majesty's puisne justices of the newly formed Supreme Court of Judicature. Among the many crates and trunks containing their personal effects was a huge brass-bound portfolio with a safety lock and a wide wooden back. It weighed nearly forty pounds and on it was painted "E.C.K. 1800". We can surmise that the massive container held a substantial number of sheets of the finest quality watercolour paper measuring at least three by two feet. Lady Gwillim was an artist and a naturalist. Obviously it was not her intention to be satisfied with the circumscribed social life and the official formality that were the prevailing lot of the wives of British officials in the colonies. Lady Gwillim planned to make an artistic and scientific record of the wildlife of South India.

Photographs by Leighton Warren, ROM, reproduced courtesy of The Blacker-Wood Library, McGill University.

Above: Crested Green Wood-Partridge (*Rollulus rouloul*)

Opposite page: Purple Heron (*Ardea purpurea*)





London, England, 1924: Dr. Casey A. Wood, a surgeon and ophthalmologist in search of literary material in zoology, stopped in front of the small, out-of-the-way shop of a dealer in *objets d'art*. Dr. Wood was the founder of what is now known as the Blacker-Wood Library of Zoology at McGill University in Montreal. He was also the principal collector of the books, manuscripts, periodicals, paintings, and prints for which the library is justly renowned.

On impulse, Dr. Wood entered the store and enquired of the proprietor whether he had any old drawings or paintings of birds or other animals. A search in the cellar among much half-forgotten stock uncovered a small package containing about thirty watercolour drawings of Indian fishes. Each had a mat on which was an auctioneer's printed number. Some were signed "E.G.", others bore legends in Urdu giving the native names for the fishes. There was another parcel containing a few paintings of Indian flowers, each inscribed with its English and its systematic name. Pasted

on one of the front pages of this little portfolio was a sheet marked "Elizabeth Gwillim, Madras, 1800-1806".

Dr. Wood was captivated. Being an insatiable collector and sleuth, he asked if there were more. The proprietor said not. But by fortunate chance a passing clerk overheard the conversation. Pausing, he remarked, "I think that before I went to France in 1914 I saw a collection of bird paintings downstairs." He hurried down to the cellar and in a few minutes reappeared, tottering under the weight of an immense, dust-laden portfolio five feet long and four feet wide. It was brass-bound, and had a safety lock and a wide wooden back. It was only with great difficulty that Dr. Wood was able to read a now barely decipherable caption "E.C.K. 1800". The giant container was opened to reveal a collection of 121 splendid portraits of Indian birds.

We have no record of the transaction that ensued. Did Dr. Wood contain his fervid eagerness and haggle? Did the proprietor,

ignorant of the treasure in his possession, ask a ridiculously low price? We do know that when Dr. Wood left the shop he was the elated owner of the superb paintings by Lady Gwillim and was already plotting enthusiastically a course of procedure to find out who Lady Gwillim really was and how she came to acquire the artistic and scientific excellence so evident in her work.

Alas, he never found out, nor has anyone else. Elizabeth Gwillim remains an enigma to this day. Dr. Wood wrote (*Ibis*, 1925), "I have consulted all the ordinary and most of the extraordinary sources of information that would occur to one interested in the matter, but with meagre results." Genealogists, officials of the India Office, librarians, government records and newspapers in England and Madras, museums, parish registers—all were consulted and probed by the persistent scholar. He even travelled to Madras and found Lady Gwillim's grave in St. Mary's Church at Fort St. George, Madras, and copied the inscrip-



tion cut into the pavement of the historic church, near the front entrance:

ELIZABETHA
PIA CONIUX
HENRICI GWILLIM EQ. AUR.
VIXIT ANN. XLIV. MENSES VIII
H.S.E.
MDCCCVII.

All that we know of Lady Gwillim is as follows: Elizabeth Gwillim (maiden name unknown but presumed to begin with K) was born (about) 21 April 1763. She came to Madras with her husband, Sir Henry, in 1800, died on 21 December 1807 at the early age of forty-four, and was buried in St. Mary's Church, Fort St. George.

Montreal, Canada, 1973: As a consequence of the Royal Ontario Museum's decision to present an exhibition of the finest in wildlife art in the fall of 1975, Peter Buerschaper and I visited the Blacker-Wood Library in search of original artworks by the masters. We knew through articles by Dr. Wood in the 1925 issue of *Ibis*, and in his book, *An Introduction to the*

Literature of Vertebrate Zoology, that Lady Gwillim's originals were in the library. We also knew that the late Dr. Wood had been a man of rare perception and an able critic and evaluator of wildlife art. His praise of the paintings had aroused our curiosity, but since none of them had ever been reproduced we had little idea of their true merit. So we were quite unprepared for what we saw when Miss Eleanor McLean, the head librarian, opened a big folder and revealed to us the artwork. Painted two decades before Audubon published his illustrious *Birds of America*, the Gwillim bird portraits can rightfully be said to be among the finest ever done of Asian birds.

I was in a particularly fortunate position for evaluating the work. I had been in the state of Madras in 1963 and had become acquainted with virtually all the species illustrated by Lady Gwillim. I had collected some of them and had made detailed studies of them, with special reference to those parts which lose their colour

shortly after death: the beak, feet, eye, naked orbital skin, combs, and wattles. No two individuals of any animate species, whether human, bird, insect, leaf, or blossom, are precisely alike—at least, perfect duplicates have yet to be found. At the same time there are ranges of size, colour, and form, within which all members of a given species fall. So it is with the colouration of a bird's unfeathered parts. Within certain limits the colour and markings are constant. A comparison of the Lady Gwillim paintings with recent sketches demonstrates conclusively that she used living birds and/or freshly collected specimens as her models. Every detail of the living colours of these unfeathered parts is invariably accurate. Only the reds are weak, the result, probably, of Lady Gwillim's use of those notoriously fade-prone pigments, the rose madders, rather than of any inadequacy of artistic skill.

Another criterion by which a bird painting may be judged is in the artist's treatment of pterylosis. Pterylography is the descriptive



science of plumage, the arrangement of the feather tracts on a bird's skin. It may surprise some to learn that although birds' bodies appear to be fully feathered, they are in fact, only covered by feathers and these feathers are not everywhere implanted in the skin. (Exceptions are the penguins, toucans, and ostrich-like birds.) In most families of birds the shafts of the feathers grow out only in certain linear patches (pterylae), leaving large naked spaces (apteria) between them. The manner and direction in which the feathers spread out from these patches allows them effectively to overlay the naked areas and provide a complete covering, at the same time permitting the expansion and contrac-

tion of the unfeathered areas which are essential to the mobility of a flying creature. The arrangement, size, and conformation of these feather tracts differ in different families and orders of birds and, since they are constant, are important in avian classification. Similarly the feathers of a wing are constant in number and in the manner in which they overlap (a fact with which many modern bird artists appear to be unacquainted). No artist before 1800 had demonstrated the kind of intimate understanding of pterylography that is revealed in the Gwillim birds.

The easy natural postures of her birds (there is none of the strained, unnatural contortion and grotesquerie so characteristic of

Opposite page: Indian Shag
(*Phalacrocorax fuscicollis*)

Below: Brahminy Kite (*Haliastur indus*)





Above: Yellow-billed Egret (*Egretta intermedia*)

Right: Black Robin (*Saxicoloides fulicata*)

Opposite page: Whimbrel (*Numenius phaeopus*)



Audubon), combined with the accuracy of the colouring of beak and foot and the exactness of feather arrangement and pattern, strongly suggest that Lady Gwillim applied both scientific and artistic method to her work. There can be little question that she spent considerable time in the field observing at first hand the behaviour, posturing, and surroundings of her birds, and that she collected (or had collected for her) the specimens which she wished to paint. How else could she learn to portray Yellow-billed Egrets (*Egretta intermedia*) consorting together as a group, with one of their number resting on its metatarsals, while depicting the other species of white herons alone? The Yellow-bill is the only one of three species of white egrets of India that is notably gregarious at other times than during the nesting season; it is also the only one that I have ever seen in the stork-like attitude of resting on its "heels". While Lady

Gwillim manifestly was fond of the larger species which many would consider as bizarre or even repulsive—such as the vultures, adjutant storks, bare-headed ibises, cormorants, and snake-birds—she was equally proficient with the smaller perching birds—the cuckoos, swallow-shrikes, sunbirds, wagtails, and larks. Her portraits of the small Indian thrushes, known as robins and chats, capture the saucy, perky attitudes of these creatures in a way that was not to be equalled for small passerine birds until the days of Louis Agassiz Fuertes and Leo Paul Robert, a full century later.

It was at first puzzling to discover among the paintings two bird species that do not occur in India. One is a common European starling in spotted winter plumage—had Lady Gwillim painted this in England before moving to India? The other is a Crested Green Wood-Partridge, a native of the dense rain-forests of

the Malay peninsula, Thailand, Borneo, Sumatra, and Java. Then I recalled the caged-bird markets of Calcutta and other Indian cities, probably flourishing in 1800 even as they are today. The Wood-Partridge, a round, dark blue-green bird, with a huge, erect, maroon-coloured "hairy" crest on its head was just the kind of oddity that might appeal to Lady Gwillim, and it is easy to imagine her purchasing one as a pet. The fact that in the background of her portrait of the bird she has painted three more in various attitudes suggests that she had a living model to work from.

With one or two exceptions the drawings are life-size and include some of the largest species in the Old World avifauna: Grey Heron, Woolly-necked Stork, Black-headed Ibis, Bittern, Purple Heron, Short-toed and Booted Eagle. The hawks are well represented and proportionately figured; even the largest vultures



are painted life-size. It had been thought that Audubon was the first to paint full-length portraits of the largest birds, but that distinction must now pass to Lady Gwillim.

The search for information about this remarkable woman continues, but the trail grows fainter. Dr. Wood tried to trace the portfolio to its original source, but in vain. All that the dealers could tell him was that they were purchased at a "sale in the country", but exactly when and where they could not remember. From time to time the paintings had been resurrected and an occasional picture sold, usually for framing, but sometimes for decorating fire-screens.

As Lady Gwillim's numbers go up to 208, we can assume that some eighty portraits are missing. Sadly enough, the missing pictures are probably the choicest and best. It seems safe to assume that among the missing are the gorgeously plumaged Indian Roller, the oriole, the several species of kingfisher, as well as the leafbirds, the swallows, the minivets, the tree-pies, the colourful mynahs, and the trogons.

Was Lady Gwillim's husband related to Col. Thomas Gwillim of Old Court, Hereford, whose daughter, Elizabeth Posthuma Gwillim, in 1782 married John Graves Simcoe, the first lieutenant-governor of Upper Canada? Our investigations in this direction, as in all others, have ended in disappointment.

At least we can be grateful to the late Dr. Casey Wood, whose rescue of 121 Gwillim birds, together with the fishes and flowers, must be considered a contribution ranking in importance with his many other worthy achievements. And it is entirely appropriate, we think, that the artistry of Lady Gwillim, so long unrecognized, should be the feature attraction of a major exhibition during 1975—International Women's Year.



Left: Crested Hawk-Eagle (*Spizaetus cirrhatus*)

Opposite page: Brahminy Minah (*Sturnus pagodarum*)

Below: White-necked Stork (*Ciconia episcopus*)





Terry Shortt joined the Museum staff in 1930 on the day that sod was broken in preparation for the construction of the Queen's Park wing. He has held various positions in the ROM, first in ornithology, then in gallery exhibition. An interest in wildlife art and its practitioners, past and present, has been one of his avocations. He is currently engaged in assisting colleague Peter Buerschaper in the mounting of "Animals in Art", ROM's forthcoming major exhibition of international wildlife art, which will be on public display from October 7 to December 14, 1975.



The Growing Collections

The recent acquisition of a signed Tiffany vase, the gift of Miss Kathleen I. McMurrich, provides a striking addition to the European Department's collection of Art Nouveau glass. The bud-like form of the slender, thin-walled vase is reinforced by the subtle colours of the decoration in which veined green leaves flow and enfold the rich cream-coloured bud with its satin texture.

Tiffany's expressive colour transitions were achieved by the judicious application of small blobs of coloured glass to the mass of glass on the blower's rod. As the glass was blown the pre-conceived motifs, such as the foliate motifs on this vase, expanded and grew in a way which was both spontaneous and controlled. A distinctive surface iridescence was achieved by exposing the still hot article to metallic vapours, which produced extremely thin metallic films that refract light.

Particularly fine pieces of Tiffany glass were numbered after manufacture and the interpretation of the number assists in the dating of each piece. Our vase, engraved on the base with Tiffany's initials LCT and the number 3921A, was probably made about 1906.

J.B.



The steadily growing collection of portrait miniatures in the European Department has received a new addition in the form of a fine portrait of a young woman, full face on ivory, signed and dated "Menusier 1819".

Born in Metz on 6 June 1783, Jean-Pierre Menusier (Menuisier) became a pupil of Aubry and of Isabey, and was later a clever imitator of the latter. In various public collections there are miniatures which have never been fully identified as the work of one or the other. Menusier's portraits are conveniently signed, or more often initialled, and dated. The most popular are those of Napoleon I, the Empress Marie Louise, and the King of Rome, all three of which are united on a gold snuff box in the collection of the Duke of Portland (see Leo Schidlöf: *The Miniature in Europe*, vol. II, p. 551).

The example secured for the ROM surfaced in Toronto in a rather battered frame, but otherwise in good condition. It forms a proud addition to our small display.

H.H-S.

Thanks to the generosity of friends of the European Department, a small hand-paste porcelain figurine which originally appeared in the ROM "Prized Possessions" exhibit (1968), has been secured for the collections. Although only five inches tall, the figurine is modelled with great sensitivity and beauty. The crossed swords mark of the Meissen factory, painted in underglaze blue, date it to the period following 1724. The young woman carrying a small boy on her back is a fine example of chinoiserie, that is, the European attempt to reproduce Oriental designs. Such designs were very much part of Western decorative arts during the eighteenth century, especially among the products of the European ceramic factories. As a result of the glowing reports of prosperity and good government in Manchu China sent back by Jesuit missionaries and other Western visitors and the traditional Western fascination with the wealth and exoticism of the East, Oriental models came to be accepted as ideals of richness and refinement.

Although most chinoiseries followed the designs of known artists or designers, this figure cannot as yet be conclusively identified as the work of any known artist. It would appear to pre-date the well-known rococo chinoiseries of François Boucher (published c. 1750), though it does adhere to the general types of playing children and acrobats frequently found among such designs. As an undecorated piece, it invites association with the famous Japanese Pavilion, a project pursued by the Elector of Saxony during the 1720s, but never finished. Experimental pieces of undecorated porcelain survive from this project, and the

glaze of this figure appears similar to that on a dish from the Pavilion (our collections #949.243.1).

As an unusual and rare model of first quality, this piece warrants further investigation. Present evidence would seem to date it to the period 1724-44. The modeller

might possibly be J.G. Kirchner (active at Meissen c. 1727-30) or one of the trio of J.J. Kaendler, Peter Reinicke, and J.F. Eberlein, who executed what George Savage has described as a "vigorous series of chinoiseries" about 1743. C.P.K.



The first object in the Weston gift to arrive, and undoubtedly one of the highlights, is a bronze sculpture by Alessandro Vittoria. The allegorical figure of Winter, represented as an old man, is not unlike the portrait by Raphael of Pope Julius II, but is shown seated before a brazier with hands outstretched to warm them.

This fine example of Renaissance art was published by John Pope Hennessy in the *Burlington Magazine*, February 1963. Originally it must have been one in a

series of *The Four Seasons*; it was later adapted for use as a highly decorative oil lamp, or possibly an inkwell. It is of yellowish metal finished with a brownish lacquer type of patina, and is 16.2 cm. high. This Venetian work will serve as an important link in the evolution of styles between Renaissance and the much later Baroque.

The Museum is greatly indebted to Mr. Garfield Weston, who has become one of its most important sponsors.

H.H.S.



Eleven mineral species, not previously represented in our collections, have been registered in the Department of Mineralogy. The new species *mroseite*, described by Dr. J.A. Mandarino et al., was recently approved by the Commission on New Minerals and Mineral Names of the International Mineralogical Association. The name honours Miss Mary Mrose, an eminent mineralogist with the United States Geological Survey in Washington, D.C. The mineral is a calcium tellurite-carbonate from a mine near Moctezuma in Mexico, and occurs as colourless to white masses, often with a crudely radiating structure and an adamantine lustre. The actual material used for the research which led to the description of *mroseite* is called the "type material", and the few tenths of a gram remaining are preserved in the ROM collections.

The other ten species are the following: *barrerite* and *mazzite* from Italy; *lokkaite* and *caysichite* from Evans Lou Mine, Quebec; *yofortierite*, *gaidonnayite*, and *hilaireite* from Mont St. Hilaire, Quebec; *jagowerite* from Hess River, Yukon Territory, and *kinoite* from Christmas, Arizona. *Yedlinite* from the Mammoth Mine, Tiger, Arizona, was presented by Neal Yedlin of Connecticut.

Mr. Dennis Lea, president of the Walker Mineralogical Club, presented some fine *cryolite* crystals from the Francon Quarry in Montreal. Mr. R.P. Bowen of Nevada presented some exceptionally large and fine *colemanite* crystals from Death Valley, California. In addition, a small collection of micromounts of minerals from the newly discovered phosphate occurrence in the Yukon Territory was added to the micromineral collection. R.I.G.



The Far Eastern Department's acquisition of a hanging scroll by the Ming Dynasty literatus-artist Wen Bo-ren (1502-75?) will have special interest for those who have had or will have opportunity to visit China. Its subject, the "Lion Grove" in Suzhou of Jiangsu province, is one of the few landscaped architectural monuments which has been preserved and restored, to be the delight of all who treasure a romantic vision of China in the past.

This garden was originally planned for a temple at the site by the monk Tianru weize about A.D. 1342. Its name may refer either to the Buddha's lion throne, or to rocks which resemble crouching beasts. Strangely shaped mineral formations, produced by water erosion in the lake Taihu, are among the distinguishing features of this fantastic environment, in which natural and man-made elements are framed and reflected by an artificial lake. The photograph illustrated with our

painting was kindly submitted by Dr. Doris Dohrenwend, Assistant Curator, who took it on her visit to China in 1973.

The painting's inscription dates it to 1571, thus placing the work as a mature production. A long inscription above is by Wen's friend Lu Shi-dao (active from 1538), who was equally famous as poet, calligrapher, and painter. Lu wrote ten verses commemorating a visit to the garden in late spring; these poems providing the inspiration for Wen's painting. This collaboration will remind students of Chinese art history of a famous artists' gathering in the garden at an earlier date; that recorded by the Yuan Dynasty master Ni Zan (1301-74). The painting and calligraphy of the scroll both evoke the literati tradition that dominated Chinese art until very recently. Its addition to the collection continues the Department's concentration upon this mainstream in the painting of the Far East.

H.Y.S.





Ancient Man at Fengate

Britain's Past on the Move

Francis Pryor



The low-lying Fens of East Anglia in England have for centuries been an intriguing place. Throughout English history they have served as hiding-places for countless rogues, rascals, and foes of foreign overlords—the Romans, the Normans, or whoever the latest conquerors of the country happened to be. In recent years, on the edge of these Fens, a ROM team has been excavating the interesting site of Fengate, which lies on 500 acres of an industrial suburb of the modern city of Peterborough. Our first four seasons, from 1971 to 1974, have told us a lot about the ways prehistoric man adapted to this site's special and changing surroundings, and are helping us as archaeologists to give flesh and blood to the inhabitants of ancient Britain. Fengate's location on the economically valuable lowlands, which until recently were tidal marshlands, and its proximity to the River Nene made it an important settlement area in ancient times.

Far left: Soil for phosphate analysis being removed from the hand soil-drilling tool.

Below: The ring-ditch of the later neolithic/Bronze Age settlement (2000-1400 B.C.), excavated in 1973.





The site has been known to archaeologists since 1910 when it was first established as an important prehistoric settlement location spanning many periods. More recently, Cambridge University aerial photographs have shown that the modern fields of Fengate conceal a wealth of buried information, just seventy-five centimetres below the surface. Unfortunately, the whole site is about to be engulfed by the rapid expansion of Peterborough New Town, probably within the next five years. However, by the end of our project we hope to have stripped and excavated between thirty and thirty-five acres, which we trust will be a significant sample of the whole.

Our approach to the problems posed by so large a site must be broad if we are to make sense of the widespread tangle of occupation features, such as storage pits, wells, field-boundary ditches, wall-foundation trenches, drainage gullies, or the ubiquitous post-holes, any one of which could date from some time between 4000 B.C. and A.D. 400. We cannot afford to make selections by "culture" or by chronological period if we are to understand the continued development of the site over such a long time. Our sampling criterion must be based on space, as we could never conceivably hope to strip and excavate all 500 acres. To compensate for the small size of our sample, we take great pains to dig what we expose as thoroughly as possible.

Now to hand-strip the areas required of us would take about fifty years and would be quite out of the question, even if the site were not threatened by industrial expansion. Similarly, to hand-trowel the contents of every pit and ditch thus revealed would take another fifteen years or so, given our present crew and budget. So we have to compromise. The overburden is removed by machine, but the techniques we use are so gentle that we no longer find it necessary to clean the exposed surface by hand. We



Opposite page: Wicken Fen, Cambridgeshire. This nature reserve of undrained fenland shows what the Fens probably looked like 4,000 years ago.

Left: The flotation unit in operation. Soil is being washed, and the organic material is collected in a fine-mesh sieve below the V-shaped weir.

Below: Close-up of seeds and other plant material emerging from the flotation unit.



then excavate most linear features, such as track ditches and field-boundary ditches, with forks and shovels. Small modified hand-shovels are used in a way that ensures that the earth is searched at least three times before it is removed. In addition, we also have to use controlled sampling procedures which usually involve the use of several shaker screens, made for us here in Canada.

Our digging techniques, however, would not be able to throw much light upon the settlement patterns of prehistoric communities in the area, if we were to ignore the environment in which these communities lived. The interaction of a society and its environment is a two-way affair, and we cannot understand the people as living beings unless we can set them in their proper

context. So it behoves the archaeologist to study the environments of ancient societies as minutely as possible, and to try to account for the causes of any changes observed by putting forward plausible explanatory hypotheses whose validity can then be checked in the field, given the right circumstances.

Fengate is a site where the permanent water level is only two metres below the surface. Consequently, the preservation of plant and other organic remains is excellent and provides much data for reconstructing the ancient environment and for testing the validity of our explanatory hypotheses. Our botanical samples are usually obtained from the deeper levels of pits or wells. Using pieces of old pipe, strips of steel, chicken wire, and a fifty-gallon oil drum, we have built a

makeshift but practical "flotation unit". This apparatus uses very slowly flowing water to separate plant, animal, and insect material from its waterlogged silt matrix, and is able to process a barrow of earth every two hours. For stickier soils, such as wet clay, we have to adopt a more laborious procedure involving very fine mesh geological test-sieves and various chemicals to aid particle separation and subsequent flotation. Without these techniques botanists and other specialists would have to spend extra hours in the laboratory with vast amounts of damp soil—hardly an inducement to scientists to join the project.

The analysis of animal bones found on the site provides us with an important guide to the composition of an ancient economy. At present we have no means of consolidating our earliest,

neolithic (c. 4000 B.C.) bones, which would probably not stand up to the strain of an Atlantic crossing, and so these have been studied in Britain. Our Bronze Age, Iron Age, and Roman bones are much stronger, however, and these are currently being studied by Kathy Biddick, a University of Toronto Ph.D. student, under Dr. Howard Savage's supervision.

The soil at Fengate is very acid indeed, and we can never be sure that bones of smaller domesticated animals, such as pigs, sheep, goats, or dogs, may not have been chemically destroyed, leaving us with an apparent preponderance of larger bones, such as those of oxen or horses, and a distorted view of the economy under study. However, here the waterlogged deposits come into their own once again, for they are most likely to contain the minute eggs of parasites, which often tend to select one species in preference to any other. And so a large quantity of, say, sheep parasites would cast doubt upon any analysis of bones that suggested that the community in question based its economy exclusively on cattle. Thus with two techniques we have a

measure of control.

Other modern techniques are useful both in suggesting and in testing hypotheses. In 1974 we made extensive use of the "phosphate analysis" method of site surveying. Soil phosphate analyses, kindly performed for us in the Research Laboratory of the British Museum, allow us to pinpoint areas in which men or animals may have been living for extended periods in the past. Last season we interpreted a series of Bronze Age (here 1200–800 B.C.) ditches as part of a system of ancient stockyards. We had plenty of good reasons for coming to this interpretation, but we knew it would be much more satisfactory if we could somehow check the hypothesis using an altogether different, "independent" source of information. Phosphate analysis provides such a source. For a few days two of us—myself and a colleague at the British Museum—will take soil samples along the ditches of the Bronze Age stockyards we excavated last season. If the hypothesis is true, we expect the phosphate levels to be higher near gateways and along tracks or

droves, owing to a concentration of manure in these areas. A low concentration spread evenly over the site would tend to disprove the hypothesis.

But what have our sophisticated techniques managed to tell us already about the past? What have been the probable main trends of settlement at Fengate since 4000 B.C.? Much remains hypothetical, but facts alone lack flesh and blood and need to be given life. As Sir Mortimer Wheeler put it, "Dead archaeology is the driest dust that blows."

Apart from hints on post-glacial hunter-gatherers provided by a few stray finds, we found indications that the first serious settlers at Fengate were early neolithic farmers who arrived on the site about 3700 B.C. They lived in widely separated rectangular houses, probably in woodland clearings. Like all subsequent groups, they must have relied heavily on the Fens both as a source of peat, reeds, fish, or eels and, during the dry, flood-free summer months, as grazing land. As far as we can tell, their economy was mixed, with equal reliance placed on cereal



Above: Excavating a deposit of later Iron Age domestic pottery (c. 50 B.C.).



Right: Parallel and right-angled field-boundary ditches of the Middle Bronze Age "stockyards" (1200-900 B.C.) excavated in 1974.

crops and on domesticated animals. They made fine flint implements and coarse undecorated pottery, which is among the earliest known in Britain.

By about 2000 B.C. the picture had changed beyond recognition. The forest clearance around the Fen margins was almost complete, and the countryside was largely treeless, apart from odd clumps of hazel. Otherwise, grass and bracken predominated among a flora that included many weeds usually associated with settlement. Brambles were common, and their fruit, blackberries, has been found particularly well preserved. We know of at least three communities of this period which saw the introduction of permanent land-management techniques in the form of ditched stock enclosures. These are perhaps the earliest known fields in Britain. Instead of living in isolated households, these people of the later neolithic and early Bronze Age were probably far more centralized, and may perhaps have instituted the first chiefdom societies of the true Bronze Age. Settlement was probably seasonal.

The Fen islands and their margins would have provided lush summer grazing for the settlers' cattle herds, but the people would have returned to the flood-free Fen margins during the winter months. Here, where pasture was greatly reduced in winter, it became necessary to introduce land-management systems, both to conserve grass and to keep wild cattle, which we know were eaten, away from the domestic herds. In the community we excavated in 1973, we have been able to distinguish areas for flint tool preparation, for cooking, and for family living. The last of these three areas probably went out of use by about 1300 B.C.

Between 1400 and 1200 B.C. the pattern again changed somewhat, and although the economic base and seasonal migration remained as before, the stock-enclosure

system became much more sophisticated. These Middle and Late Bronze Age enclosures, which we will phosphate-survey in 1975, are laid out at right angles to the Fens and form a carefully surveyed, regular network of boundary droveways separating linked rectilinear enclosures. The system as it survives today covers an area about a third of a mile square. Rubbish found in these ditches includes some of the earliest evidence for salt evaporation anywhere in Europe. Some of the flintwork is very fine, but in general both pots and flints are of much poorer quality than their neolithic predecessors. There could be many reasons for such apparent "degeneration". For example, the decline may in part reflect a more widespread use of bronze, which might have helped to change the emphasis from other materials. What we *cannot* say, is that "degeneration" in the few artifacts that have survived these 3,500 years is a reflection of general "degeneration" within the society as a whole. Still, despite their poor showing in pots, our Bronze Age farmers were able to survey and construct a most elaborate field system, for which they must have needed a fair degree of centralized authority and complex land tenure arrangements. They were also able to own fine metalwork, as the socketed spearhead we found last season attests.

The site has also produced pottery and flint tools made by a distinctive group of people who lived in Britain during late neolithic and Early-to-Middle Bronze Age times. These groups came from the Continent, most probably from the Low Countries and the Rhineland, and brought with them the art of metalworking, and a highly distinctive style of pottery for which they have been named the Beaker folk. The Fengate Beaker features, usually small domestic refuse pits, are scattered evenly over the whole site, but do not appear to fall into distinctive clumps or

clusters. As no ditches, houses, or wells can be directly attributed to the Beaker folk, they still remain a mystery. They may have occupied the site during the summer months when the larger groups of neolithic and Bronze Age pastoralists were taking advantage of the Fen grasslands.

With the arrival of the Iron Age after 900 B.C. the pattern again altered drastically. Field-boundary ditches ceased to be used, and there is evidence that mixed agriculture involving cereal crops and a variety of livestock appeared. Round houses are found for the first time, too, perhaps suggesting a return to a more settled, if not permanent, way of life. The standards of workmanship and technology also improved, and towards the end of this period we find the first use of the potter's wheel and evidence for somewhat larger populations. The transition from the Iron Age to the Roman period appears to have been gradual at first, and so probably the Roman conquest of A.D. 43 did not have a very startling effect on the local peasantry. However, things changed rapidly after Queen Boudicca's (the "Boadicean") revolt of A.D. 60-61 and its subsequent bloody suppression. A Roman road, the Fen Causeway, which traverses part of the site may have been constructed in connection with this rebellion.

Next season we are to dig a Roman farm. It is probably post-Boudiccan in date and does not seem to bear any relation to what had gone before. Farms of this period are not common in the immediate area and this one may have been built to provide food for the soldiers and engineers employed by the central government to drain large tracts of the Fens in the first and early second centuries A.D. It is hard to say how long the farm was actually used, but recent excavations would suggest that it did not survive long into the third century. There is no mediaeval or Saxon material at the site. The heavy floods which

deposited large quantities of clay in the immediately post-Roman decades may help to account for its absence. We should, however, be able to fill this gap in our knowledge by referring to the copious records kept from early mediaeval times in the neighbouring Fenland abbeys.

So it would appear that a great deal of movement, relocation, and change—processes that are going

on in the area to this day—marked the efforts of ancient man to find better ways to adapt to his surroundings. The change was for the most part a gradual process, and if we now have difficulty understanding why communities behaved the way they did, there is one consolation: the facts are there, somewhere, in those 500 acres; all we have to do is find them.

Crouched burial of a teen-age girl found in one of the Middle Bronze Age field-boundary ditches in 1974.



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